APPENDIX V

RESPONSES TO PUBLIC COMMENTS on the NOVEMBER 2004 REPORT

We appreciated the comments received on the November 2004 draft report. They have helped further refine the content and strength of the report.

ACCESS BUSINESS GROUP

Comment: ARB continues to cite consumer products as a source of TACs without considering the abundance of evidence obtained in the VOC reduction program for ambient air quality. Exposure of consumers to TACs is unlikely due to a variety of US product safety regulations and voluntary efforts of manufacturers. ARB has focused reformulation on the highest use products.

> **Response**: Based on information available, the report accurately characterizes sources of these compounds and uses caveats such as "at the time the study was conducted". "Consumer products" is a broad term, and, as noted in the comment, not all types of consumer products are regulated by ARB. Additionally, the U.S. product safety regulations referred to are generally labeling requirements or other requirements that do not require removal of potential TACs from the product.
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> We acknowledge in the report the achievements at eliminating TACs in consumer products. However, accessing the ARB database of solvents that can be used in consumer products, we find well over 100 solvents of varying properties and health effects are listed in the database. The database also indicates the mass emissions of various VOCs from consumer and commercial products. Data indicate that tons of VOCs are released on a daily basis, with spray hair styling products being the highest emitter of pounds of VOCs.

Comment: Table ES-1 is a confusing collection of data. Endocrine disruptors are listed as pollutants without much evidence that they are found in indoor air. DDT has been discontinued as a chemical in US commerce for many years. "Organic chemicals" seems misleading since most of the products listed do not contain the listed pollutants.

> **Response**: Table ES-1 is designed to give the reader a quick overview of the many categories of indoor air pollutants. ARB believes it has highlighted the categories of pollutants most often discussed and studied in the scientific literature. To meet the intended purpose of the table, pollutants, sources, and potential health effects have been grouped together. A footnote was previously added that explains that each pollutant may not cause all of the health effects listed in the third column. A good summary of concentrations of endocrine disruptors in indoor air and on house dust is provided by Rudel et al. (2003). Although the sale of DDT was prohibited many years ago, it is detected in house dust in virtually every study that analyzes for it. It is extremely persistent in the environment.

Comment: The listing of personal care products and cosmetics as a source of formaldehyde is speculative. Such use has largely been discontinued. When it was present, emissions were trivial.

> **Response**: Fingernail products were very high emitters of formaldehyde in the Kelly et al study of formaldehyde emissions funded by the ARB and completed in 1996. In an unpublished study of products purchased from California retail stores, Akland and Whitaker (2000) found formaldehyde in several fingernail products and a few other personal care products as well. Emissions were not necessarily trivial, and most importantly, personal exposures of the users of the products clearly could be quite high.

Comment: The report states, "Low emission product designs or reformulations can usually be accomplished by the manufacturer, with minimal impact on the consumer, often with only minor increased costs." This is not likely to be true if further reductions in consumer product emissions above those already achieved in the ambient air VOC emissions reductions. Further reductions at each phase of regulations have been more difficult and more costly.

> **Response**: We agree that as regulated products are further regulated, the incremental reductions are more costly per unit of pollutant reduction. However, ARB regulates only a limited number of consumer product categories; there is room for emissions reductions in categories that are not currently regulated. There may also be opportunity for further reductions in building materials and appliances.

Comment: In Section 1.4 "Environmental Justice Considerations Relative to Indoor Air Quality", the citation of pesticide residues in carpeting and room freshener use seem unnecessarily critical. It seems appropriate to encourage those who live in substandard housing to use appropriate consumer products to deal with pests and malodors.

> **Response**: Data relating indoor air quality to environmental justice issues are scarce. The two citations provided on pesticide and air freshener use are appropriate to include in this section. The Department of Health Services and private organizations participate in asthma intervention programs to educate low-income individuals to improve their environment by reducing asthma triggers. Proper use of cleaning products is undoubtedly part of the educational curriculum. However, preventive measures are preferred over pesticide use.

Comment: Section 2.3.3, "Volatile Organic Compounds", seems confusing as VOCs are cited when specific toxic or irritant VOCs are intended. Most VOCs have no adverse health effects at the levels found in indoor air.

> **Response**: VOCs studied by the scientific community in indoor air are reported in this section. In many cases indoor concentrations are below health benchmark levels. However, studies indicate that those homes at the high end of distributions may experience unsafe levels of specific VOCs. Additionally, those with carcinogenic potential are sometimes elevated above one in a million or one in a hundred thousand risk levels. .

Comment: The section on VOC emissions from consumer products has many examples of misinformation. For example, chloroform is cited as a consequence of laundry and dish washing when neither would be a likely source, absent chlorine bleaching. Instead the use of municipally treated water is the likely cause of ambient chloroform. ARB has the opportunity to use the

survey information on VOC from the consumer products ambient air program to correct these errors.

> **Response**: The release of chloroform from the use of chlorine-containing cleaning agents during wash cycles does indeed occur and the report provides appropriate citations. Prior to discussing this source, the report discusses the release of chloroform from treated domestic water, particularly during showers. Additional citations will be added to the report.

AMERICAN CHEMISTRY COUNCIL, PHTHALATE ESTERS PANEL

ARB Comment regarding phthalate esters: The Office of Environmental Health Hazard Assessment, reviews and assesses the toxicity of chemicals and conducts risk assessments. Questions related to the toxicity of DEHP and other phthalate esters have been referred to OEHHA for response. OEHHA has not been able to respond to all of ACC's detailed comments on phthalates. Additionally, many of those detailed comments go beyond the scope of this report. ARB has corrected the IARC classification of DEHP and made other edits accordingly. Responses to some key comments are provided here. Following OEHHA's response to other comments, the final report will be revised as appropriate.

Comment: The report is technically correct in stating that DEHP is in IARC Group 3, not classifiable as to human carcinogenicity. The summary fails to present the heart of the IARC's conclusion – that "the mechanism by which di(2-ethylhexyl phthalate increases the incidence of hepatocellular tumours in rats and mice is not relevant to humans" (IARC, 2000). Suggested alternate wording for the report is provided.

> **Response**: OEHHA has not responded to the comment on mechanism. Based on the IARC assessment of phthalates, it is correct to say that there is inadequate evidence of carcinogenicity of DEHP in humans, but that there is sufficient evidence in experimental animals for carcinogenicity. This information is included in the report on pages 38-39.

Comment: The final report should not indicate that other phthalates are carcinogenic. Three pages in the report are identified where it is implied that phthalates are carcinogenic.

> **Response**: The reference to other phthalates as potential carcinogens was removed from Appendix II, but the text of the main report was inadvertently left as before. We will review the final version of the report for those statements and correct as needed. Also, based on the IARC reclassification of DEHP to Group 3, the one case of cancer from DEHP in the Comparative Risk Project was subtracted from the indoor cancer risk estimate, leaving a total of 232, instead of 233, estimated cancers. Because of rounding, this change did not affect the estimate of 230 excess cancers per year used in the main report.

Comment: It is misleading to refer to all phthalates as endocrine disrupters. Comments provided in June indicate the weight of evidence demonstrates that phthalates neither mimic nor interfere with estrogen and androgen; some, but not all, phthalates have been shown to cause lowered testosterone levels when administered to rodents at very high doses.

> **Response**: We will change the wording to reflect this in the final version of the report.

Comment: Measured levels of phthalates in indoor air are far below animal effect levels. A previous ARB response indicates that a complete evaluation of their prevalence in indoor air would be undertaken prior to any recommendations regarding these chemicals. The levels are so low, they are a very low priority, consideration should be given to removing phthalates entirely from the report.

> **Response**: We agree that a complete evaluation would be undertaken prior to any recommendations specific to phthalates. However, because DEHP and other phthalates may act as endocrine disruptors, phthalates should remain in the report.

AMERICAN CHEMISTRY COUNCIL, SOLVENTS COUNCIL

Comment: The draft report still fails to adequately assess potential health risks because it fails to compare indoor air VOC concentrations to relevant health benchmarks. The mere inclusion of benchmarks with no additional discussion to put these benchmarks into perspective does little to help the reader accurately assess the potential risk, if any, posed by exposure to indoor air. The comment then lists five specific chemicals and requests additional discussion of those chemicals relative to the benchmarks identified for them.

- **Response**: The appropriate benchmark comparison for a 1 in 100,000 cancer risk level was provided for VOCs in Table 2.7. Additionally, the benchmarks for formaldehyde are included in the text, and comparison to Figure 2.4 is made simple because the benchmarks are included in the figure. Benchmarks were included in the text for other chemicals as well, as noted in the commentor's comments. When benchmarks are presented in the text, it is assumed the reader can determine if the relevant concentration is above or below the benchmark. We do not believe that the additional detailed discussion requested for each chemical is appropriate for this report. The report also states that there is no level of exposure that is known to be absolutely safe for carcinogens. Thus, for those compounds identified as carcinogens, any elevated concentration above the concurrent outdoor levels is undesirable, and indicates the presence of one or more indoor sources. Whether such sources need to be, or should be, mitigated, depends on many factors.

Comment: The report presents a misleading impression of VOC health risks because it lumps "VOCs" together in a single, undifferentiated group. For example, the reference to "VOCs: cancer" in Table ES-2 should be changed to "Selected Known or Suspected Carcinogens," and a footnote added to explain the cost estimate is the sum of cost estimates derived for a certain number of compounds. The mention that indoor and outdoor air pollution have been identified as contributors to an increase of asthma is overly broad and undefined. More discussion should be included on the Institute of Medicine report regarding pollutants and asthma.

> **Response**: The report reflects that VOCs are comprised of a large number of chemicals. The heading "VOCs: cancer" is explained in the health and cost sections, and is more informative and specific than the heading suggested. Appendix II clearly lists the chemicals that were included in the cancer risk estimate. Tables 2.2 and 2.3 are copied from the Institute of Medicine (IOM) report, with the citation provided and accompanying discussion in the text. If a reader needs to further explore indoor exposures and exacerbation or development of asthma they should read the IOM report.

Comment: The prioritization scheme is improved but still fails to represent accurately the relatively minor risks and costs associated with indoor air VOC exposure. Products should be

listed as “high” priority only if it can be demonstrated that exposures exceed or can be reasonably anticipated to exceed relevant health benchmarks. Hodgson and Levin (2003) conclude that “for a very few compounds, such as acrolein and formaldehyde, the evidence based on sensory irritation and chronic toxicity is sufficient to warrant efforts to reduce and otherwise control the sources of these compounds in buildings.” A quantitative prioritization is needed to determine whether a “comprehensive program” is required.

> **Response**: The purpose of the report was to provide an overview of sources and health effects of indoor pollutants, list existing regulations and practices for mitigating exposures, and describe options and recommendations to improve indoor air quality. A quantitative prioritization is needed if a comprehensive program is implemented, but that work is outside the scope of this report. The statement by Hodgson and Levin (2003) is based on sensory irritation and chronic toxicity, but does not address carcinogenicity. As mentioned above, for carcinogens, there is no level of exposure that is known to be absolutely safe.

Comment: The report still fails to explain adequately that its estimate of excess cancer cases from indoor air VOCs is very conservative and probably greatly overestimates actual risks, which could be zero. The report should include more detailed discussion of the uncertainties inherent in estimating potential excess cancers and the highly conservative nature of its upper-bound excess cancer estimates. The report should include more discussion of Wallace (1991) which states that the risk may be zero.

> **Response**: The VOC cancer risk estimate is based on risk calculations in the Comparative Risk Project (CCRP), and only the excess cancers for the population estimated to be exposed above a one in 10,000 risk level were counted. The procedures used in the CCRP were peer-reviewed, and represent standard practice in health risk assessment. Additionally, as stated in Appendix II, the CCRP estimate does not include all VOCs and semi-volatile chemicals that are known or suspected carcinogens. For example, PAHs other than B(a)P, and aldehydes other than formaldehyde, are not included, yet there are known indoor sources of those compounds.

Comment: The report does not demonstrate a need for new legislative authority to regulate VOCs. The majority of VOCs, when compared to health benchmarks present little or no health risk. Focusing on VOCs will divert resources away from more hazardous air pollutants, such as ETS and radon.

> **Response**: The report does not focus on VOCs. In the high priority group, only building materials are sources of VOCs. However, as indicated in the report, while indoor VOC levels typically do not exceed non-cancer health benchmarks, a number of them have been measured indoors at levels above their respective cancer risk levels of concern.

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

Comment: AHAM disagrees with the prioritization of sources. Air cleaners and combustion appliances should not be on the high priority list and vacuum cleaners should not be on the medium priority list.

> **Response**: The focus of the air-cleaners category is on those air cleaners that generate ozone, especially those that generate ozone purposely, to supposedly clean the air

(stated in the table). Vacuum cleaners are included in the group of household appliances and office equipment, although the focus of the group is computers, copy machines, and printers, which can be sources of pollutant emissions. While the group is medium priority, vacuum cleaners were included, since they can sometimes re-suspend substantial amounts of particles. There are some very good vacuum cleaners on the market; vacuum cleaners would be a low priority in this group. The report also recommends the development of innovative clean air technologies for indoor air, which could include improved air cleaner, vacuum cleaner, and combustion appliance technologies.

Comment: AHAM believes there is disagreement regarding the validity of activity pattern study data from the 1980s and 1990s, and recommends further research and discussion with stakeholders to update information on time spent indoors.

Response: We are unaware of studies showing any substantially different results from the early activity pattern studies, in terms of time spent indoors and outdoors. Subsequent to ARB's studies, a large national surveys and local field studies have replicated the general findings on time spent indoors. We believe that the other areas indicated in the report warrant higher priority for research.

Comment: The ARB response to an earlier comment indicates that recommended mitigation options for improved public education and professional training would address the misuse of outdoor cooking appliances. However, the draft report still does not clearly reflect this important point. As another example, the public should be educated to follow industry-recommended cleaning guidelines for humidifiers. Consumers must bear some responsibility for maintaining their appliances.

Response: The text was revised to include more discussion of public and professional education and outreach strategies. However, we believe it is largely industry's responsibility to educate their customers regarding recommended cleaning and use of appliances.

Comment: The report fails to mention, by definition, the combustion of natural gas creates by-products and therefore, zero-emitting gas appliances are not technologically feasible. A recent study by the Gas Research Institute found the ANSI/Z21/83 standards have such a high margin of safety that they do not need to be changed. (Citation provided)

Response: Direct-vented (sealed-combustion) appliances are virtually zero-emitting in terms of indoor emissions. For example, direct-vent gas furnaces and gas fireplaces are very energy efficient, are resistant to backdrafting, and have been used widely for years. Direct vent gas stoves were developed by the Canadian Gas Research Institute in the 1990's but have not been marketed widely. The report will be revised to clarify this topic.

It is not clear that the ANSI/Z21/83 standards would assure healthful levels of indoor NO_2 and aldehydes as well as CO, especially over the lifetime of the appliance with typical maintenance levels.

Comment: Two letters are provided from the Consumer Product Safety Commissions regarding studies conducted at NIST. These studies state that the current ANSI Z21.1 standards for emission contain sufficient safety margins. CPSC concluded that no changes are necessary to

the voluntary safety standards. AHAM believes a full survey of homes and buildings is needed to develop a baseline data set.

> **Response**: While the standards may be sufficient for safety (prevention or death) purposes, we believe they are not sufficient to adequately protect health. The referenced modeling studies address indoor CO, and, in fact, show that the ARB's IAQ guideline and state ambient air quality standard would be exceeded. For example, the 1-hour and 8-hour guideline level would be exceeded in the baking scenarios with smaller kitchen volumes and lower air exchange rates. The medium and lower air exchange rates used in the modeling are not as low as those are for some new or weatherized homes in California. This modeling estimate does not include the contributions of outdoor CO levels, which can be substantial at times. Further, these studies do not address what is typically the limiting factor for combustion appliances: indoor NO_2.
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> A full statewide survey of gas appliances in homes and other buildings is not necessary. Rather, testing, development, training, and verification are needed to improve the design, operation, and maintenance of combustion appliances and their venting systems.

Comment: AHAM objects to most of the proposals in Section 7, "Options to Mitigate Indoor Air Pollution". Establishing emission limits specifically for California is not justified. Stakeholders participate in standard development groups such as ANSI and ASTM, which are designed to ensure products do not diminish indoor air quality. ARB staff are encouraged to participate with these standards development groups.

> **Response**: We commend those working on ASTM and ANSI standards that include consideration of indoor air quality. However, ANSI and ASTM standards are not based on California housing and environmental factors, and may not adequately protect our citizens' health. Additionally, they are not required to be met by all manufacturers. ARB actively participated in the development of UL/ANSI standards for indoor products in the past, but unfortunately did not result in standards; we will participate in the future as resources allow.

Comment: The report utilizes incorrect data and assumptions. Specifically, it states that there are no industry consensus standards for vacuum cleaners. ASTM International has a technical committee, ASTM Committee F11 for Vacuum Cleaners (established in 1972). This committee has 28 industry consensus standards for vacuum cleaner performance. The committee undertakes new initiatives. Currently under review is a standard for determining the change in room air particle counts as a result of vacuum cleaning.

> **Response**: The upcoming standard for airborne particles appears to be the only standard that addresses IAQ directly. The final report will be revised to incorporate information on any existing performance standards that protect indoor air quality at that time.

Comment: The ASTM F11 committee members undertake new initiatives aimed at developing standards for those performance characteristics not yet covered by the current standards. One of those….is the development of new standards for determining "the change in room air particle counts as a result of vacuum cleaning." The lack of such basic information (about the initiatives) in the report indicates the ARB should work with stakeholders to gather current and accurate information rather than seek authority for emission standards. As an example, ARB should

work with industry to get more reliable data on usage patterns of range hoods in homes before making any recommendation.

> **Response**: We commend the ASTM F11 committee for moving forward in this area. However, development of consensus test methods is different from developing limits that must be met. Such information is not "basic information" on indoor air quality that negates the scientific findings in the report. Regarding the specific example given, there is sufficient information available to conclude that range hood use and design are often inadequate. The ARB activity pattern studies and other studies confirm that range hood use in homes is very limited. Additionally, the ARB residential cooking study and other studies show that range hoods are not always very effective. New and existing information on this topic would be considered in developing a risk reduction strategy.

CalAG, LLC

Comment: CalAg, LLC has developed a patented technology for the production of MDF from California rice straw. The product uses a formaldehyde-free polyurethane resin in the binding process. Panelboard product will be on the market by early 2007. MDF made with agricultural fibers and MDI resin will have no off-gassing and will be a substitute for any application that currently uses wood based MDF. Laminates could be applied for decorative purposes, but would not be needed to reduce off-gassing.

> **Response**: Thank you for providing panelboard products that do not emit formaldehyde for consumers. The report mentions some alternatives currently available, thereby indicating it is feasible to produce low-emitting products. Your products further substantiate that alternatives are available.

CALIFORNIA WOOD INDUSTRY COALITION (by Venable)

Comment: Please explain the Chemical Industry Institute of Toxicology (CIIT) risk assessment from 1999 in the final report. The CIIT report's quantitative results should be expressed in addition to and in distinction to those of OEHHA and its acceptance by other national and international governmental bodies be acknowledged.

> **Response**: In November 2002, ARB and OEHHA denied a petition to formally review the CIIT formaldehyde risk assessment. The petition was based in part on the potency estimate change associated with the CIIT 1999 report. OEHHA determined that the report was a new analysis of old evidence rather than new evidence. OEHHA stated that more information is needed to evaluate the risk assessment model used by CIIT, and that it needs to be peer-reviewed and validated. In the future, if formaldehyde risk assessments are reevaluated, information stemming from this work may be considered.

Comment: Recommend removal of the point estimates of risk, or if used, put them into context by also referencing the Maximum Likelihood Estimate (MLE) expression of the California model and the CIIT results in close proximity. Although statements are included regarding 95% Upper Confidence Limit, they are not carried throughout the report. Appendix II discussion reflects the CRP report as a basis of point estimate of risk, a practice the CRP authors considered Inappropriate. The Appendix does not even mention the fact that a statistical UCL expression was used.

Response: In the CCRP, the cancer potency value used to estimate risk was the 95th percentile value, which is standard practice in cancer risk assessments. The CCRP methods and procedures were reviewed and approved by a peer review committee. However, the full distribution of exposure values were used for the calculation (not a high end value), and only the portion of the population with estimated risk above the 1 in 10,000 level were included in the calculation of estimated cancer cases. Had cases with less than a 1 in 10,000 risk level been included, the estimate would have been much higher. In reviewing available data on formaldehyde and other carcinogens, ARB staff found that the CCRP provided the most robust, California-specific analysis of indoor exposure and risk, and that is why the CCRP estimates were used as a starting point. The formaldehyde estimate was cut in half, as described in Appendix III, based on reductions in emissions quantified by an ARB-funded study that showed that emissions from the most common formaldehyde-emitting products and materials had decreased by 49%. The resulting estimate of 62 excess cancers per year compares very well with the 98 nasopharyngeal cancers per year (average of reported cancers from 1998-2002) reported by the California Department of Health Services' cancer registry. The remaining nasopharyngeal cancer deaths are likely the result of occupational exposures to formaldehyde, which may at times be higher than residential exposures. However, workplace users of formaldehyde typically have the benefit of engineering, administrative, and personal protection controls not used by occupants of new mobile homes, classrooms, or other buildings. Thus, some new building occupants can experience higher exposures to formaldehyde over a longer period of time (more hours per day, and more days per week) than would many workers who use formaldehyde in their workplace.

We will review our discussions further and include additional caveats regarding the uncertainty in any such estimates in the final version of the report. However, we will not remove the formaldehyde estimates provided, because, as explained below, they are relatively robust, and supported by current nasopharyngeal death rates.

Comment: Regarding independent laboratory testing for emissions, it is not practical to test a complex product such as furniture. Pieces vary considerably by size, composition, construction techniques, etc. It would be impossible to develop a test protocol that would capture meaningful information on consumer furnishings, per se.

Response: Multiple protocols may be needed to test all types of furniture, but this is not an impossible task. Some types of furniture have already been tested for emissions. Precedent has been set for emissions testing of modular office panels and furniture for the Capitol East End Project. These pieces were purchased in a very large order and manufactured under controlled conditions. We acknowledge other types of furniture may have more variety in the components and are manufactured under a variety of conditions. This topic has been discussed related to the formaldehyde Air Toxics Control Measure. ARB will pursue continued discussions with industry if the recommendation to develop an emissions testing procedure is implemented.

Comment: We are curious as to why some references to the ongoing ARB ATCM proceeding have been eliminated (pages 26 and 104 of June draft report). The Coalition is proud of the cooperative effort that is underway in working with ARB staff over the last four years.

Response: ARB appreciates the cooperative attitude the composite wood industry has maintained in working on the formaldehyde ATCM. Reference to the effort was removed from the Executive Summary because the ATCM is not yet in effect, and the specific timeline is uncertain. It is still included in the body of the report in Section 4.3.3.1.

Comment: Thank you for adding results of the ARB survey in context of the ATCM proceeding on page 60. The results are of a chamber concentration, and could be mistakenly interpreted as the ambient level in a home. Please clarify.

Response: A statement was added to the report to clarify that chamber concentration does not equal the level in the interior of a home.

Comment: There is one inaccuracy regarding industry standards. The CPA lowered the large chamber emission limits for certain particleboard products, thus they are not identical to HUD standard for mobile homes.

Response: Wording was appropriately adjusted in the report.

CLOROX

Comment: The correlation between asthma and bleach (page 37) is inaccurate. The Rosenman et al study cited in the report lacks scientific rigor.

Response: Authors of the Rosenman et al. (2003) study examined a database of work-related asthma cases associated with cleaning products, reported primarily by physicians between 1993 and 1997. The article discusses limitations of the database: limited documentation of pulmonary function; identification of the causal agent is based on history; and the database contains only a minority of the work-related asthma cases for the study states. However, the paper provides further citations for new-onset work-related asthma occurring after a documented exposure to cleaning products, and more citations for exacerbation of pre-existing asthma from such exposures. The large number of cases reported would indicate an association exists between asthma, bleach, and other cleaning products.

Comment: Cleaning products when used in the manner directed are part of the solution and not the cause of asthma. The report fails to recognize the benefits of cleaning products to mitigate the effects of asthma. Two citations provided.

Response: The role of cleaning properly with spray and liquid disinfectants and other cleaning products is included in Section 5.5, *Building Operation and Maintenance,* and highlighted in the Executive Summary. Cleaning products can reduce bacteria and mold on surfaces, and reduce exposure to them. Despite this benefit, some can influence indoor air quality in a manner that requires attention to proper use and potential trade-offs. Thus, preventive measures that reduce the need for cleaning products are highly desirable.

CONSUMER SPECIALTY PRODUCTS ASSOCIATION

Comment: CSPA continues to be concerned about the undue emphasis on indoor emissions that present little or no health risks while failing to highlight more significant risks. ARB fails to fully appreciate the rigorous federal product safety regulations that govern formulated consumer products as well as the efforts of manufacturers of those products to assure product safety. The report understates the regulations affecting products used indoors. The Executive Summary dismisses U.S. Consumer Product Safety Commission (CPSC) regulations.

> **Response**: It is not clear which indoor emissions CSPA believes are insignificant. We believe that all indoor emissions of carcinogenic compounds and irritant compounds are potentially significant, and must be considered in light of other factors such as the presence of multiple indoor sources, extent of infiltration from outdoors, length of duration of exposure, and so on. A brief synopsis of the jurisdiction CPSC has over consumer products is presented in the Executive Summary. More detail is provided in Section 4.3.1.1 including information on the Federal Hazardous Substances Act. This Act provides guidelines for determining if a substance is "toxic", and has labeling requirements including the use of specific signal words. However, CPSC's actions are focused more on safety than health, and CPSC only infrequently prohibits a specific component in a product.

Comment: The report fails to adequately consider the public health and indoor air quality benefits of many of the formulated consumer products, articulated in Attachment C to our previous comments. Please include Attachment C and A to the website and in the next version of the report.

> **Response**: The report acknowledges that many consumer products have beneficial effects. Section 5.5 "Building operation and maintenance" discusses the need for regular building maintenance, as well as the beneficial aspects of regular and effective cleaning. Attachments A and C were added to the Clorox comments on our website.

Comment: Table ES-1 improperly aggregates large classes of pollutants with a wide range of properties, toxicity, sources, and health effects. Only the most toxic pollutants likely to be present indoors should be listed and individually paired with its sources and effects. The category of "Organic Chemicals" is particularly misleading. Issue is taken with air fresheners and cleaning agents, aerosol sprays, candles, and endocrine disrupters.

> **Response**: Table ES-1 is designed to give the reader a quick overview of the many categories of indoor air pollutants. ARB believes it has highlighted the categories of pollutants most often discussed and studied in the scientific literature. To meet the intended purpose of the table, pollutants, sources, and potential health effects have been grouped together. The footnote explains that each pollutant may not cause all of the health effects listed in the third column. The table contents are supported by information presented in the rest of the report. Research has shown that "air fresheners" contain VOCs and can have irritating effects on some members of the population. Candle smoke and aerosol sprays contribute to particulate matter. Further information on these sources and on endocrine disruptors, including citations, is in the relevant sections of the report.

Comment: Results of the Rosenman et al. (2003) study and Delfino (2002) review have not been accurately characterized in the Draft Report. There is no clear evidence that these VOCs

are associated in any causative way with asthma. Epidemiological studies such as this are often subject to confounding factors that mask actual causes.

> **Response**: The report does not indicate that these studies purport a causal relationship, but rather an association with asthma symptoms (in individuals with asthma), or exacerbation. See the response to comment submitted by Clorox, above, for further information on the Rosenman et al study as well.

Comment: The report is correct to note that the specific causes of SBS have not yet been firmly identified. However, it is contradictory and speculative in implying that "irritant chemicals" are suspected (Executive Summary).

> **Response**: Refer to Section 2.1.3.2 for a more complete discussion of SBS. Irritation of the eyes, nose, and skin is generally associated with factors such as low ventilation rate, recent renovation or remodeling, and sources such as photocopiers. These factors lead the scientific community to conclude that some component of gaseous or particulate pollution is the source of the irritation.

Comment: The report lists candle burning as a potential source of harmful PM. It is not clear what size particles are being discussed. In the Executive Summary, the report does not analyze the differences in the physics and chemistry of particles outdoors and indoors, including the greater tendency indoors for particles to agglomerate and fall out, and to be captured in sinks such as fabrics and carpeting. Studies have shown that particulates from candles are above the one micron range, and therefore are not considered respirable.

> **Response**: The information requested is discussed in the body of the report in Section 2.2.1. PM from indoor sources, including that from combustion sources, is emitted in a variety of size ranges, including sizes above and below one micron, all of which can contribute to health impacts, as described in the report.

Comment: The term "Pesticides" is a broad term. Pesticides are regulated by state and federal agencies. They undergo numerous tests and are not capable of producing "adverse developmental and neurological effects". Pesticides used indoors do not persist for long in the environment…synthetic pyrethroids last only six to seven weeks before degrading.

> **Response**: In Section 2.3.5, the report briefly discusses different categories of pesticides and their concentrations measured in air and house dust. Indeed, pesticides are extensively regulated and the results of many types of toxicity tests are required to register a pesticide. Nonetheless, they can cause adverse effects on humans when exposure is elevated. The California Department of Pesticide Registration maintains a Pesticide Illness Surveillance Program. In 2002 (the most recent year data is available), there were over 1,000 doctor-reported illnesses associated with occupational and non-occupational exposure to pesticides. Although some newer pesticides do not last as long as some older ones, they nonetheless persist for some time, and that time may be longer in real homes than anticipated. At the 2004 annual meeting of the International Society of Exposure Analysis, several speakers noted their findings that some pesticides appear to last longer indoors than previously estimated, possibly due to the lack of weathering (rain, sun) and temperature extremes in indoor locations.

Comment: Expand the review of biological contaminants in the Executive Summary.

Response: We believe the discussion of biological contaminants in the Executive Summary is an appropriate length.

Comment: The discussion of environmental justice properly notes that many biological asthma triggers are likely to be present in locations where lower income individuals most often live. Unfortunately, by stigmatizing cleaning products that eliminate many biological contaminants, ARB is reducing the likelihood of mitigating these pests.

Response: Environmental justice issues associated with asthma triggers are far more complex than indicated here. Spengler and others have shown that preventive measures are most effective in reducing asthma triggers and preventing exposure to them in low income households. Asthma intervention programs managed by the Department of Health Services and private organizations are working to educate low-income individuals to improve their environment by reducing asthma triggers. We do not believe we have stigmatized cleaning products in our report, nor do we believe that low income households will throw away their cleaning supplies due to the content of this report.

Comment: Table ES-2 and Table 3.6 show that the vast majority of estimated costs are associated with ETS and radon. It is unfortunate that cost estimates for biological contaminants such as infectious diseases were not included. The CDC estimates that infectious diseases result in Americans spending more than $950 billion on direct medical costs.

Response: We acknowledge the magnitude of the health impacts and costs of infectious disease in the U.S. However, infectious diseases can be transmitted through routes such as personal contact, and shared food and utensils among families. It is not feasible in this document to identify the portion of infectious disease that is solely attributable to indoor air quality.

Comment: Table ES-2 implies that all VOCs cause cancer. The few VOCs contributing to this alleged risk should be specified here.

Response: The Executive Summary relays the highlights of the major findings in the report. Please refer to Section 3.1.2, “Deaths From Volatile Organic Compounds (VOC) Exposure” for details on the cancer calculation. Appendix II clearly lists the chemicals included in the cancer calculation. However, as noted in Appendix II, not all VOCs that are carcinogens were accounted for in the estimate.

Comment: In the Executive Summary, it is stated that low-emission product designs or reformulations can usually be accomplished by the manufacturer, with minimal impact on the consumer, often with only minor increased costs. This statement is patently false. Industry’s experience working with ARB regulations indicates it is difficult to maintain product efficacy during reformulations. Costs in many categories have been substantial.

Response: That sentence refers to the increased costs to the consumer, which typically are minimal. Costs for reformulations and product changes vary by industry, by facility, and by other factors, such as whether the changes can be implemented as part of other planned modernization or other product changes. In the ARB regulatory framework, ARB conducts economic analyses for proposed regulations. A full analysis would be conducted if regulatory changes were implemented. It should be noted that, in a review of the estimated vs. actual costs of implementing mobile source rules, US EPA found that the actual costs of changes required by rules were much less than those estimated

by the relevant stakeholders, and even less than those estimated by EPA (JF Anderson and T Sherwood, 2002, Comparison of EPA and Other Estimates of Mobile Source Rule Costs to Actual Price Changes, Presentation at the SAE Government Industry Meeting, Washington, DC, May 14, 2002.)

Comment: CSPA likes the segregation of sources into high and medium priority tables. The high priority source categories are well-documented and should be the focus of any state activities for the remainder of the decade.

Response: We are glad you are in agreement with our prioritization.

Comment: The report states that "non-toxic cleaning products are currently sold in the marketplace." Unfortunately, that viewpoint does not take efficacy into account. The legitimacy of "non-toxic" claims is questionable.

Response: Websites for environmentally friendly products and sensitive populations tout "non-toxic" alternatives to many products. The message is that alternatives to standard products are available to do the intended job, though they may take more abrasive action, a period of contact before removing, etc. We agree with your question about legitimacy. A self-proclaimed statement about safety carries little weight. That is why we are promoting several recommendations to mitigate indoor air pollution through emission limits, emission testing, and a comprehensive management system for indoor air quality.

Comment: Table ES-3.2 and Table 6.2 should be edited because very few of the consumer products listed emit the pollutants listed as examples. Also, the table does not acknowledge the comprehensive federal regulatory system in place.

Response: The CPSC has regulated some products, but usually they have used labeling requirements instead of emission limits or content limits, although some such actions have been taken. Many products are not regulated for their impact on indoor air quality. Therefore, federal regulatory efforts have not been adequate for indoor air quality concerns.

Comment: We do not need a management system for indoor air quality nor need to require consumer products to be tested for emissions.

Response: Noted. Our reasons for our recommendations are spelled out in the report.

Introduction and Background

Comment: We are uncertain which "room fresheners" are described on page 32 when referring to Wiley et al. (1991).

Response: In this case, room fresheners included any of several products such as aerosol, plug-in devices, or those that work through evaporative diffusion.

Health Impacts, ETS

Comment: It is not true that a high concentration of an aerosol spray is inhaled during product use. The spray from these products is highly directional to provide product to the intended target.

> **Response**: The report states that "a high concentration of the chemicals consequently may be inhaled during product use before the chemical has a chance to become more dilute in the air". Despite the fact that the spray is directional, solvent is released into the air in the vicinity of the user, where it is likely that some fraction of it will be inhaled. People also move around when using some aerosol sprays, such as when washing windows, thus increasing the likelihood of inhaling the aerosol.

Comment: CDC data indicate that the rate of Americans experiencing an asthma attack in a 12-month period has declined in the last few years.

> **Response**: The rate of asthma attacks may have gone down due to efforts to use preventative medicines to manage asthma. Asthma treatment is not the focus of this report.

Comment: Tables 2.2 and 2.3 indicate asthma is associated primarily with agents of biological origin. There should be more focus on biological contaminants in this discussion.

> **Response**: There is substantial discussion of biologicals in the report.

Comment: Discussion based on the 10-year-old CCRP is of limited relevance because many product reformulations have occurred. Consumer products have very limited amounts of formaldehyde, greatly reduced para-dichlorobenzene, and no trichloroethylene. An updated study should be a condition for any new initiative on indoor air pollution.

> **Response**: As discussed above and in the report, the CCRP estimates were adjusted (down) where new data are available. Some products used in homes and public buildings still contain toxic air contaminants, so we believe our estimates are appropriate. However, as stated in the document, development of a comprehensive program would include collection of additional information and further assessment.

Comment: The referenced study by Fan et al. (2003) is described in a very misleading manner. The authors conclude that the best strategy to reduce indoor reactivity would be to lower outdoor ozone levels.

> **Response**: The report lists the conclusions of Fan et al. (2003) in the same order that the author lists them. The first suggested method for mitigation states "it is prudent to limit the use of products that emit high-reactivity alkenes during episodes when outdoor ozone levels are elevated".

Comment: The section on particulate matter contains only a single paragraph on biological contaminants. o provide an accurate and balanced perspective, a more thorough review of biologicals should be provided here.

> **Response**: Biological contaminants are discussed fully in Section 2.3.4, hence they are given cursory treatment in the PM section.

Comment: It is inaccurate to say that consumer products are a source of formaldehyde. Some coatings and adhesives may emit formaldehyde, but most of our industry's formulated household consumer specialty products to not.

> **Response**: Some types of coatings, sealants, caulks, adhesives, cosmetics, and wallpaper can all emit formaldehyde. Whether or not formaldehyde is an ingredient in a consumer product, it also can be produced through reaction of some emitted chemicals with other chemicals present in the indoor environment.

Comment: Use of the broad term "Volatile Organic Compounds" to represent a very narrow class of chemicals that may present health concerns is misleading. "Sources and Emissions of VOCs" contains dated or inaccurate information. Some chemicals such as benzene, toluene, and para-dichlorobenzene have been greatly decreased in consumer products since the 1991 EPA TEAM studies were conducted.

> **Response**: Based on information available, the report accurately characterizes sources of these compounds and uses caveats such as "at the time the study was conducted". The report cites more recent studies than the TEAM studies for all chemicals. The paragraph on para-dichlorobenzene includes citations from Wallace, 2001 and Gordon et al., 1999. The paragraph on benzene states that the overwhelming source of benzene exposure for smokers is mainstream cigarette smoke, as well as exposure from auto exhaust and gasoline vapor emissions. Akland and Whitaker (200) detected toluene most frequently in auto care products, glues, and personal care products, such as in fingernail polishes.

Comment: The section on VOCs is grossly misleading because it fails to acknowledge that the mere existence of a VOC in indoor air does not mean there is a risk of adverse health impacts. Many VOCs are not Toxic Air Contaminants and do not present health impacts at the levels at which they exist in indoor air.

> **Response**: The report does not state that all VOCs are harmful. The report highlights the chemicals that have been studied in indoor air and are considered by the general scientific community to be indoor air pollutants. In some cases, chronic RELs or other health benchmarks are included so the reader can compare reported concentrations to levels that are expected to be free of adverse health impacts. However, if a chemical is a carcinogen, there is no known safe exposure level. For a full review of levels associated with health impacts, please search the OEHHA website.

Comment: Issue is taken with results reported from several studies cited in the report (Akland and Whitaker, 2000; Zhu et al., 2001; Cooper et al, 1995).

> **Response**: The report reflects findings from those studies that were conducted on products available at the time. Akland and Whitaker (2000) was included because, although not published, all data were obtained from products purchased in retail stores in California.

Costs

Comment: Data in Table 3.2 are highly misleading. In some cases cost data are given where etiology has been reasonably established. In other cases, the costs are less certain (ETS

cancer and heart disease). The estimate for VOC lung cancer is even more uncertain. It is misleading and grossly inaccurate to present the same value for "low", "average", and "high" estimates.

Table 3.3 suffers from the same problems as Table 3.2, as it mixes cost estimates of very different types. "VOCs: cancer" is not a diagnosable health end point. Suggestions are provided for a better column heading and replacement term for "VOCs: cancer".

> **Response**: The tables in Section 3 are intended to provide an overall estimate of the known costs of indoor pollution. The costs for ETS cancer and heart disease are fairly robust; they are based on estimates published in an EPA document in which all immediate medical costs are summed. The text in Sections 2 and 3, and Appendix II, describes the meaning of the word "cancer" in the VOC risk estimates. The range or confidence intervals in the health risk estimates are discussed in detail in the risk assessment for ETS by OEHHA. Those values will be finalized after the ARB Scientific Review Panel has completed their review of OEHHA's estimates. The confidence intervals for VOC carcinogens are not provided in the final Comparative Risk report; that is why the same values are shown in all columns. In the final report, we will delete the VOC estimate in the high and low columns and use a "not available" designation.

Methods to prevent and reduce, to the end

Comment: In Section 5.2 "Ventilation", ARB fails to distinguish between ASHRAE Standard 62.1 for commercial and high-rise residential spaces and 62.2 for all other residential spaces. We would like to issue caution regarding addendum "n" to 62-2001. Addendum "n" reduces the prescribed minimum ventilation rates for many spaces, based on low-emitting European buildings. We urge California to not adopt those lowered ventilation rates and potentially jeopardize the health of many Californians.

> **Response**: The two ASHRAE ventilation standards are discussed in Section 4, see Residential Guidelines and Nonresidential Guidelines.
>
> In setting ventilation standards, the California Energy Commission must consider protection of IAQ. ASHRAE standards along with other information are considered in developing these ventilation standards; stakeholder input is encouraged.
>
> Thank you for mentioning the low-emitting buildings in Europe. Such buildings highlight the fact that low-emitting alternatives are available and that other countries give indoor air quality a higher priority than the U.S.

Comment: Mitigation options should include recommendations for biological contaminants because they present the greatest health risks and costs in California. We are concerned that consumer products are included among materials requiring emissions testing and labeling.

> **Response**: Mitigation options for biological contaminants are being addressed by the Department of Health Services, federal agencies, and local agencies. Consumer products are one of several types of products that are recommended for emissions testing; however, they are in the medium, not high, priority group.

DEL ORO

Comment: Remove negative statements about the health effects of d-Limonene and citrus terpenes. These misleading conclusions will have a negative effect on the American citrus community.

> **Response**: The June 2004 draft report included some poor wording regarding the effects associated with terpenes. Language was improved in the November 2004 draft and is no longer misleading.

DURAFLAME (Cline & Duplissea)

Comment: Manufactured firelogs are not a contributor to indoor pollution. Banning fireplaces in new construction is overkill. Suggest that consideration be given to middle-ground solutions that have scant controversy and easy public acceptance. Indoor Air Quality standards would create a large, intrusive and potentially expensive bureaucracy with scant health benefits. Mandates that impact personal habits are difficult to enforce. Recommendations for ICAT should include new and existing products that are clean-burning, such as manufactured firelogs.

> **Response**: We appreciate your development of a lower-emitting product. Such middle ground options would be considered in the development of any comprehensive program, or any regulations. It is not our intent to enlarge bureaucracy, nor to impose mandates that impact people's choices. Rather, as indicated in the report, changes can be made at the manufacturing stage, or in the design and construction of buildings, that would greatly improve indoor air quality.

FLORIDA CHEMICAL COMPANY, INC.

Comment: We would like ARB to remove a statement on page 36 regarding the reporting by Delfino of a self-reported asthma prevalence associated with several chemicals including terpenes and limonene. The statement is misleading and will lead to false conclusions. Scientific literature reports that d-limonene and other terpenes are used to alleviate asthmatic and respiratory symptoms.

> **Response**: The results of the study cited by Delfino are pertinent to the report. The report also contains a caveat that the effects seen may be subject to confounding by other causal agents.

Comment: Several arguments are made to change language in the report regarding the reactivity of terpenes with oxidants to produce formaldehyde and ultrafine PM. Generally, the comment suggests that the word "terpene" be removed from the report. It is pointed out that conditions used to demonstrate reactions have been laboratory experiments with levels greater than normally observed indoors. Wilkins et al.(2001) conducted studies on isoprene, rather than terpenes.

> **Response**: The important message is that several investigators are confirming that these chemicals with double bonds react with oxidants present in indoor air to produce irritating compounds. The paper by Long et al. (2000) clearly shows the generation of

ultrafine PM as a result of cleaning with a product containing terpenes under typical household conditions. This paper measured the production of particles from various typical indoor activities. Particle production from mopping was exceeded by particle production from frying and burning food. It is true that the Wilkins study investigated the reactivity of isoprene. However, other studies cited, in addition to Wilkins, were conducted with terpenes.

Comment: Scientific literature is not fully quoted, resulting in an inaccurate relaying of information. Test conditions should be included in the report.

Response: We believe that the report as written accurately relays the authors' findings and conclusions. The test conditions of the studies cited are typical, accepted approaches for identifying reactions and health impacts.

FORMALDEHYDE COUNCIL

Comment: The costs attributable to VOCs (2% of total indoor air costs) do not justify the emphasis on VOC reduction in indoor air. A quantitative prioritization, while apparently beyond the scope of this project, is a necessary step prior to taking action under a comprehensive program to address indoor sources.

Response: The cost estimates do not necessarily reflect the full extent of exposure and risk in California. As stated in the report, cost estimates reflect the availability of cost information and the length of time a given pollutant has been studied. We do not believe that there is an undue emphasis on reduction of indoor VOCs in the report. The high priority source categories emit a variety of pollutants, including criteria pollutants, allergens, radon, and VOCs. As stated in the previous responses to comments, a detailed prioritization based on quantified criteria would be an appropriate step prior to taking action under a comprehensive program.

Comment: The cancer risk assessment methodology developed by the CIIT Centers for Health Research should be referenced in the final report. Eleven papers have been published over the past four years on this work. It has undergone extensive review by U.S. EPA, Health Canada, and has been used by other agencies around the world. Other efforts to refine the understanding of risk associated with exposure to formaldehyde are anticipated (IRIS and NCI epidemiology study). The report should acknowledge these forthcoming developments because they may validate the CIIT approach. Recommendations in the report may not be implemented for many years, additional information may be available at that time.

Response: In November 2002, ARB and OEHHA denied a petition to formally review the CIIT formaldehyde risk assessment. The petition was based in part on the potency estimate change associated with the CIIT 1999 report. OEHHA determined that the report was a new analysis of old evidence rather than new evidence. OEHHA stated that more information is needed to evaluate the risk assessment model used by CIIT, and that it needs to be peer-reviewed and validated. In the future, if formaldehyde risk assessments are reevaluated, information stemming from this work may be considered.

Comment: ARB should reconsider mitigation strategies associated with formaldehyde, particularly the relationship between outdoor and indoor exposure levels. With outdoor levels above the guideline level, consider the feasibility of a strategy that would seek to make indoor

exposure levels lower than outdoor levels. Also consider that in schools, adequate ventilation, and uncomfortable temperature and humidity levels are also problems of concern. The draft Report gives an extremely misleading impression that the problem of elevated formaldehyde in classrooms must be corrected immediately. Outdoor formaldehyde levels also so not meet the chronic REL guideline.

> **Response**: Indoor formaldehyde levels are several times greater than outdoor levels; thus, there is a great deal of room for improvement in indoor formaldehyde concentrations. Reduction of formaldehyde levels in schools with elevated indoor concentrations is indeed considered a very high priority by ARB, because in some classrooms the levels are many times the levels considered acceptable even for prevention of acute effects, and the occupants are children. If regulations are developed to reduce formaldehyde levels in indoor air, the ambient air concentration will certainly be taken into account: we would not expect indoor levels to be lower than outdoor levels. However, we do not agree with the rationale suggested, which is that nothing should be done indoors because outdoor levels also exceed guidelines (to a much lessor degree). The majority of the exposure and risk is from the elevated indoor concentrations, which are several times higher than outdoor levels.

Comment: Misleading statements about formaldehyde levels in indoor air abound. Two examples are provided. Include statements (caveats) about the feasibility of meeting health guidelines based on outdoor levels.

> **Response**: The statements you quoted from the report are correct as written. Formaldehyde levels nearly always do exceed chronic health-based guideline levels and acceptable cancer risk levels. It is also true that it is generally not feasible to achieve levels below these guideline levels because outdoor levels average about 3-5 ppb. If regulations are developed to reduce formaldehyde levels in indoor air, the ambient air concentration will certainly be taken into account. No further discussion is needed regarding ambient formaldehyde concentrations.

FRAGRANCED PRODUCTS INFORMATION NEWORK

Comment: Fragrances are intentionally added to numerous products such as cosmetics, detergents, candles, cleaners, etc. By definition, fragrances are volatile organic chemicals. The fragrance industry is primarily self-regulated with little oversight. Of 54 fragrance materials that are used at 1 million pounds or more annually only 2 have a full set of basic toxicity data. Scientific literature includes citations that fragrances can be a sensory irritant, a lower airway irritant, and trigger for asthma.

There is a limited awareness about the fragrance issue in the general population or the medical and scientific communities. Thus far, the industry has not adequately addressed concerns regarding the impact of multiple sources of fragrance on indoor air quality and health. There is an immediate need for regulatory agencies to educate on the impact of scented consumer products on sensitive populations. Research is needed to determine mechanisms by which fragrance negatively impacts respiratory health. There is a need for a cooperative process with industry to determine problematic materials and find suitable substitutes.

> **Response**: We appreciate the information provided by the Network. We share the Network's concern regarding fragranced products, and agree that further research in this

area is needed. Some information was added to the report, and we will include fragranced products in the list of area of research needs in the final report.

GAS APPLIANCES MANUFACTURERS ASSOCIATION (GAMA)

Comment: On page 150, vented and unvented combustion appliances are combined into one category without distinction. Vented products meet national performance standards that do not allow combustion products to be emitted into the living space. Readers need to know this piece of information.

Response: The text will be revised at a later date to reflect the report's preceding discussions of the risks from unvented or poorly vented combustion appliances. As discussed above (under AHAM comments), vented products other than direct-vent models can emit pollutants into the living space.

Comment: Page 122- SCAQMD emission limits for gas water heaters in homes will be postponed until 2006, not 2005 as stated in the report.

Response: Thank you, this will be updated in the final version of the report.

Comment: The statement that design changes for appliances can be made with minor increased costs are not correct. Industry expenditures to develop water heater systems that meet new NOx limits total many millions of dollars, ultimately to be borne by the consumer. The discussion of the porous insert technology does not include costs to incorporate this feature into a complete gas appliance system (gas stove).

Response: Costs for design changes for appliance vary by industry, by facility, by appliance, and by other factors, such as whether the changes can be implemented as part of other planned facility modernization or appliance changes. In the ARB regulatory framework, ARB conducts economic analyses for proposed regulations. A full analysis would be conducted if regulatory changes were implemented. It should be noted that, in a review of the estimated vs. actual costs of implementing mobile source rules, US EPA found that the actual costs of changes required by rules were much less than those estimated by the relevant stakeholders, and even less than those estimated by EPA (JF Anderson and T Sherwood, 2002, Comparison of EPA and Other Estimates of Mobile Source Rule Costs to Actual Price Changes, Presentation at the SAE Government Industry Meeting, Washington, DC, May 14, 2002.)

The text will be revised in the final report to add a caveat concerning the system design for incorporating the porous insert.

HEARTH, PATIO, AND BARBECUE ASSOCIATION

Comment: The draft report does not distinguish between conventional and certified wood stoves, and in so doing overestimates the emissions of wood stoves. Since 1992 all wood stoves have to be certified which results in a reduction of PM and PAH emissions. Additionally, they must operate with their gasketed doors firmly closed. As a result, certified stoves cannot leak pollutants into the indoor environment. It would be appropriate to recommend that conventional wood stoves be replaced with certified wood stoves.

Response: The report mentions the U.S. EPA emission standards for certified woodstoves. Those standards are for emissions to the outdoors; such stoves may have lower emissions to the indoors, but those emissions can still be substantial. The federal standards do not require door seals or the catalyst to be maintained over the life of the stove, nor do they prevent woodstoves from being operated with leaky doors. Any stove can leak into the room while the stove is being stoked.

Comment: The report fails to establish a direct link between emission to the ambient atmosphere and decreased indoor air quality for hearth products. Examples are provided of local air districts that require limited wood stove emissions to the ambient air, but their impact on indoor air quality is not stated. The report also mentions energy efficiency standards for certain hearth products and requirements for a permanently open flue damper for certain applications. The discussion assumes, without any supporting information, that a more efficient appliance will benefit indoor air quality. A strong causal connection must be made between these recommended control measures and an improvement in indoor air quality.

Response: As stated in our responses to this comment on the previous draft report, the large study in two California cities by Sheldon et al. documented the infiltration of outdoor PAHs from neighborhood woodburning on indoor PAH levels. In addition, several studies have shown that a major part of outdoor PM can penetrate into homes, as discussed in Section 2. Finally, ARB and air districts receive a number of complaints each winter from citizens who live in neighborhoods with woodburning who are bothered by woodsmoke entering their home from outdoors.

Comment: The report imprecisely concludes that fireplaces are a significant source of carbon monoxide. The report cites a study by Sheldon et al., in which “a fireplace” – presumably one unit in one home – caused a violation of a CO standard. It is important to identify if this was a wood or gas log fireplace. It would be extremely unlikely for a woodburning fireplace to cause a violation because the occupants of a home would quickly detect improper venting. Gas fireplaces are designed and tested to minimize CO generation and leakage. Such incidents are generally due to improper installation and/or operation. It appears the significance of one fireplace has been exaggerated in the report. Please remove fireplaces from Tables ES-1 and 2.1 unless a clearer and stronger discussion of fireplaces as a source of CO can be provided.

Response: Fireplace emissions of PM, PAHs, aldehydes, and other pollutants in addition to CO are also a health concern. It was not specified whether the one home with a fireplace that exceeded the CO standard had a gas or woodburning fireplace. However, Sheldon et al. also found that several homes had CO levels between 5 and 9 ppm that exceeded ambient levels, indicating a significant indoor source of CO. A smoldering fire that produces a high level of CO may not necessarily produce enough smoke to alert the occupants, especially if they are sleeping at night, which is a documented scenario for CO poisoning. Additionally, backdrafting can occur, bringing CO and other combustion pollutants back into the living area. We recognize that this is not usually die to fault design, but rather to other factors; however, it needs to be considered in assessing fireplaces (and other combustion devices) in terms of their potential impact on indoor air quality.

Comment: The report has placed wood stoves and fireplaces too high on the ranked list of pollution sources for mitigation. Hearth products when properly installed and maintained will not significantly contribute to contaminants in indoor air. Industry is working with U.S. EPA, under

the auspices of ASTM International, to develop standards for a wood-fueled fireplace that will emit fewer particles. ARB must consider the benefits of potential mitigation approaches, whether effects will be direct or indirect, how significant the improvements will be, and the size of the population that will benefit.

> **Response**: The category of "combustion appliances" remains in the high priority group because one or more combustion appliances are present in virtually every home, and because gas stoves and some other devices are unvented, leading to a high potential for emission and exposure. However, this does not mean that every device would warrant changes. A full analysis would be conducted if measures are to be pursued to address indoor combustion appliances. For its existing regulatory programs, ARB conducts economic analyses prior to taking action.

INSTITUTE OF MEDICINE

Comment: Several corrections or improvements were recommended, with specific language changes provided. Suggested wording changes are subtle, but make statements align perfectly with IOM reports.

> **Response**: Thank you, the suggested changes were implemented.

MANUFACTURED HOUSING RESEARCH ALLIANCE

Comment: There have been changes in manufactured homes construction that result in overall reduction in formaldehyde levels. Specifically, there has been a dramatic reduction in the use of UF-bonded wood products. This was not addressed in the revised report. The response to comments that 4 homes in Florida is representative of California is flawed.

> **Response**: Hodgson et al. (2000) state that the formaldehyde levels in manufactured homes are approximately 50 percent of what they were two decades ago. He attributes this to construction changes, such as less paneling, and reduced emissions from the products relative to 20 years ago. This is consistent with conclusions from a formaldehyde emissions study conducted by Tom Kelly at Battelle (1996). These statements are included in the report. ARB acknowledges that conditions in Florida may not be representative of conditions in California, but there are some areas of California that are similar to Florida, and there is no published data countering these results. It is important to note that there are other sources of formaldehyde besides building materials in a new home. Examples include wallpaper, draperies, furniture, and gas appliance use. We would agree that a study of new manufactured homes would provide useful information.

DAVID MORALEZ, Davis, CA

Comment: Gratitude is expressed for the long overdue report. Support is offered for the recommendations listed to make meaningful progress to protect the public from unhealthy indoor air. Ideally the recommendations would be supported with funding.

> **Response**: Thank you, we appreciate your positive comments.

NATIONAL PROPANE GAS ASSOCIATION

Comment: Statements related to low- or zero-emitting appliances are misleading for several reasons. Appliances are specifically designed to exhaust all of the combustion products to the outdoor air, therefore no exhaust can enter the living space when equipment is properly installed. The recommendation for zero-emitting appliances implies one should use electric appliances, which shifts the pollutants to another site (where the power plant is located).

> **Response**: Direct-vented (sealed-combustion) appliances are virtually zero-emitting in terms of indoor emissions. For example, direct-vent gas furnaces and gas fireplaces are very energy efficient, are resistant to backdrafting, and have been used widely for years. Direct vent gas stoves were developed by the Canadian Gas Research Institute in the 1990's but have not been marketed widely. The report will be revised to clarify this topic. The report also discussed the need for proper, effective, and well-maintained venting of combustion appliances and for cooking appliances, both electric and gas.

Comment: ARB recommends active exhaust ventilation to reduce pollutants from combustion appliances. This would have no impact on the appliance if the venting system is properly installed because all pollutants would be vented to the outside. Active exhaust ventilation is required to achieve the requisite number of air changes per hour in homes with tight new construction. Active exhaust could also lead to backdrafting problems.

> **Response**: Our intention is to recommend active *local* exhaust ventilation, with installation specifications that assure adequate flow and low noise levels. Such a provision would be provided if the operation of a range hood were linked to the operation of a gas kitchen stove. To prevent backdrafting, accepted measures for house-as-a-system design should be used, such as direct-vent gas furnaces, limits on flow rates for range hoods and other exhaust devices, and depressurization testing.

Comment: On page 23 of the report, an option is suggested to require manufacturers to have a third party conduct emissions testing on appliances. Appliances already receive testing during the certification process. Adding a label with results would confuse the general public. They would interpret it to mean the emissions that are deposited within the living space, which would not occur with a properly installed vent.

> **Response**: Our focus is on unvented appliances, such as gas stoves, which typically are not vented, and can emit pollutants directly to the indoor space. Because all products on the market may meet certain emission performance criteria, consumers and builders need labels and accessible information to identify low-emitting products.. This approach would be developed with input from the public, consumer groups, and other stakeholders.

PEACE RIVER CITRUS PRODUCTS

Comment: Remove negative statements about the health effects of d-Limonene and citrus terpenes. These misleading conclusions will have a negative effect on the American citrus community.

Response: The June 2004 draft report included a misstatement regarding the health effects associated with terpenes. Language was revised in the November 2004 draft, and information from recent scientific studies and related information was included. We believe that the information we provided in the November 2004 report is correct.

REGAL AIR QUALITY, INC.

Comment: We need a vehicle to identify the population that is currently at risk but don't know it and provide proper education and information for them. The report should include a recommendation that seniors be provided with monetary assistance to implement procedures to retrofit their homes for improved indoor air quality. Specifically, HVAC duct insulation can emit formaldehyde in areas with high temperatures such as Arizona. Improvements to the HVAC system and/or insulation can improve the occupant's health, but monetary assistance is sometimes needed.

Response: We agree that there is increased education needed. In California, our approach to address cost issues might be to recommend low-emitting formaldehyde duct insulation in state and utility weatherization programs for low-income households. We are not yet certain, however, whether the duct insulation used by California builders also emits formaldehyde as does the type used in Arizona. Accordingly, we have included limited measurements to be made in residential ventilation systems in a study of new homes in California, which we expect to start later this year.

RESILIENT FLOOR COVERING INSTITUTE

Comment: In October, 2004, the DHS determined that the Section 01350 limit for acetaldehyde should be something other than one-half the OEHHA chronic REL. This should be reflected in the report. Alternate wording is provided for a couple of places in report.

Response: We did not concur with DHS on this matter, but will add the information to the final report if it is accurate at that time. Our concern is that it would allow a single product to potentially contribute sufficient amounts of the chemical to exceed OEHHA's chronic REL guideline value (which for acetaldehyde is 9 ug/m^3).

SEMPRA ENERGY

Comment: They expect their comments to be shared with the scientific review panel.

Response: All of the comments received from the public on the June 2004 draft report were provided to the peer review panel when they reviewed the November 2004 document, so that they could see the comments received and how we responded to them. The peer review panel has completed their review, so will not be sent the current comments. However, if any peer review member requests them, we certainly would provide them.

Comment: Banning gas stove use would have a profound economic and social impact on the state. A study would probably show that electrocution death rates from electric cooking appliances are nearly equal to death rates from CO poisoning from gas cooking appliances.

Response: The report does not recommend banning gas stoves from homes, but rather to use alternatives such as direct vent appliances, or to improve their local exhaust and reduce their emissions. In addition to concerns regarding CO poisoning, ARB is concerned about NO2 emissions and other emissions from combustion appliances. A revision to the building standards would require a detailed analysis and public review.

Comment: An attached report (2000) conducted by the CPSC with assistance from NIST looked at CO emissions from the misuse of natural gas ranges. The CPSC declined to take any further action on setting new CO emission standards based on their studies.

Response: While the standards may be sufficient for safety purposes (prevention of life-threatening effects or death), we believe they are not sufficient to adequately protect health. The referenced modeling studies address indoor CO, and, in fact, show that the ARB's IAQ guideline and state ambient air quality standard would be exceeded. For example, the 1-hour and 8-hour guideline level would be exceeded in the baking scenarios with smaller kitchen volumes and lower air exchange rates. The medium and lower air exchange rates used in the modeling are not as low as those are for some new or weatherized homes in California. This modeling estimate does not include the contributions of outdoor CO levels, which can be substantial at times. Further, these studies do not address what is typically the limiting factor for combustion appliances: indoor NO_2.

Comment: The foods cooked and specific type of cooking activity are more important to IAQ than the energy source of the cooking appliance. For example, PAHs are emitted during cooking with electricity or gas.

Response: That is true for most PM emissions, although PM emissions (especially ulftrafine PM) are generally higher when using a gas stove. In addition, NO_2, CO, and aldehydes are always higher when using a gas stove.

SOAP AND DETERGENT ASSOCIATION

Comment: Add references to the Executive Summary for the production of formaldehyde and ultrafine PM from the reaction of terpenes and oxidants (page 5). Also, add a reference to the paragraph about VOCs on page 8.

Response: Numerous facts are presented in the Executive Summary, most of them widely accepted in the field of indoor air quality. Please refer to the body of the report to find extended discussion with references.

Comment: Household and institutional cleaners are listed as a source of several VOCs in Tables ES-3.2 (and 6.2). However, these ingredients are not intentionally added to water soluble, surfactant-based products. Therefore, these chemicals should be absent or at *de minimus* levels in the water soluble, surfactant-based products.

Response: Thank you for this information. We do not feel clarification is needed in the text because footnotes indicate all of the pollutant sources may not emit all of the pollutants listed in the corresponding box. However, such information would clearly be important in developing mitigation approaches for specific products.

Comment: The paragraph describing the types and uses of mercury does not detail the products with inorganic mercury. We recommend their inclusion.

Response: The sources of inorganic mercury are listed in Table 2.13; this is sufficient.

Comment: According to the U.S. EPA report, “Reducing Mercury Use in Healthcare: Promoting a Healthier Environment”, mercury can be a contaminant in detergents and cleansers when the mercury-cell process is used to manufacture some cleaning product ingredients. This should be statedThe products mentioned in the U.S. EPA report are down-the-drain products. Recognizing this, one would not expect any mercury that may be in a product to become air borne. Moreover, there are no validated methodologies for testing cleaning product for mercury. Therefore, reported test findings may not be actual mercury concentrations.

Response: Our report adequately states the findings from the 1999 EPA report. In fact, if we consider the statement from the EPA report that "many forms of mercury circulate in the environment, moving from land or water to air and back again," the comment to not expect any mercury in a [down-the-drain] product to become airborne does not necessarily hold true. More importantly, any mercury in products used indoors that are released to the indoor environment, even as splash droplets, will persist. Also, it may be the case that there are no validated methodologies for testing cleaning products, but the concentrations in the AB 1173 report are not being reported for cleaning products.

Comment: Add a description of the DGS EPP task force to page 120-121.

Response: The Environmentally Preferable Purchasing (EPP) Task
Force is discussed in Section 4.3.3.2 under the subheading “Sustainable Buildings and Section 01350”. EPP is also discussed in the same section under the subheading “Environmentally Preferable Products for School Construction”.

SOUTHERN GARDENS CITRUS (two commentors: Liddle and Chapman)

Comment (same comment from both commentors): Remove negative statements about the health effects of d-Limonene and citrus terpenes. These misleading conclusions will have a negative effect on the American citrus community.

Response: The June 2004 draft report included a misstatement regarding the health effects associated with terpenes. Language was revised in the November 2004 draft, and information from recent scientific studies and related information was included. The information we provided in the November 2004 report is correct.

TREATT

Comment: Remove negative statements about the health effects of d-limonene and citrus terpenes. Technical arguments will be made by others in the citrus industry.

Response: The June 2004 draft report included a misstatement regarding the health effects associated with terpenes. Language was revised in the November 2004 draft,

and information from recent scientific studies and related information was included. We believe that the information we provided in the November 2004 report is correct.

UNITED STATES DEPARTMENT OF AGRICULTURE

Comment: The report states a major objection to the use of d-limonene and other terpenes in cleaning products is due to the reaction products formed between terpenes and oxidants in the air. These compounds cause irritation without any terpenes being present. Before banning terpenes, the actual levels of formed irritants should be determined and alternatives for safe cleaning chemicals investigated. Numerous agencies do not categorize terpenes as posing health risks.

Response: We do not suggest banning terpenes: rather, we indicate that further research is needed. ARB certainly acknowledges that formaldehyde and PM are irritants, regardless of their source. However, if terpenes introduced to indoor air in cleaning products lead to significant increased levels of these irritants in indoor air, then mitigation would be warranted. Several investigators around the country and the world are studying the reaction of terpenes and oxidants to determine potential impacts on indoor air quality.

THE END